State Building Highway Link to Site of 200-inch Telescope on Palomar Peak

By **E. E. WALLACE,** District Engineer

CONSTRUCTION by the State Division of Highways of an essential link in the road to the summit of Palomar Mountain in San Diego County, the contribution of the California Department of Public Works toward increasing scientific knowledge of the universe, and which will make possible transportation to the peak of the famous 200-inch telescopic mirror and thousands of tons of material and equipment for the world's largest astrophysical observatory, now is under way.

The observatory site is at an elevation of 5568 feet and at present is accessible only over a tortuous trail from a road being built by the county of San Diego. The work undertaken by the State will, when completed, provide the final connection with the site and also furnish an approach to the Palomar Mountain State Park.

More than eight years ago the Rockefeller Foundation appropriated funds for an observatory intended to eclipse any in existence. Five years were devoted to the task of selecting a site. The location on Palomar Mountain, comprising 720 acres, finally was chosen as the most suitable.

In order to secure the observatory, San Diego County authorities agreed to provide a road to the site, and the work of improving adjacent county roads has been in progress for the past year. A new road connecting with the secondary State highway to Oceanside is being constructed by San Diego up the south side of Palomar Mountain and a total length of 11.8 miles of maintained road must be completed in order to provide proper access to the site.

This obligation placed quite a burden upon San Diego County and so the last link of the road, designated as San Diego County's Feeder Road Project, is being financed with Federal funds, which have been apportioned to the State of California under the Emergency Relief Appropriation Act of 1935, and is being constructed under the supervision of the Division of Highways.

PROVIDING RELIEF EMPLOYMENT

The Feeder Road Project involves the construction of 3.3 miles of mountain road with a 28-inch roadbed which will be surfaced with local materials. Approximately 150,000 cubic yards of excavation, mostly rock, will be moved under this contract. One of the purposes of the undertaking is to provide employment and the specifications call for 237,370 man-hours of employment.

Because of the unusual loads which will have to be hauled over the road, a rather high standard was required.

HEAVY OBSERVATORY EQUIPMENT TO BE MOVED OVER ROAD

Part	No. to be shipped	Width	Length	Height	Weight
Mirror and Cell	1	22 ft.	22 ft.	8 ft.	100,000 lbs.
Tube	1	23 ft.	48 ft.	23 ft.	125,000 lbs.
Girders	4	10 ft.	65 ft.	14 ft.	140,000 lbs.
Horseshoe	2	20 ft.	45 ft.	5 ft.	100,000 lbs.
Lower Grillage	1	23 ft.	30 ft.	6 ft.	75,000 lbs.
Cage	1	23 ft.	23 ft.	16 ft.	50,000 lbs.

The road has been located so that traffic using it will not interfere with the observatory work. The route traverses some heavily timbered country and approaches the easterly side of the Palomar State Park, which is a beautiful tract including 2.5 square miles on the top of Palomar Mountain.

AIRPORT TO BE BUILT

From the observatory site a wonderful panoramic view of the surrounding valleys and mountains, as well as of celestial bodies, is available.

An airport will be built adjacent to the observatory which will provide for plane landings for official visitors. Necessary buildings will include at least five cottages to house the observatory staff and provide quarters for visiting scientists; the observatory housing

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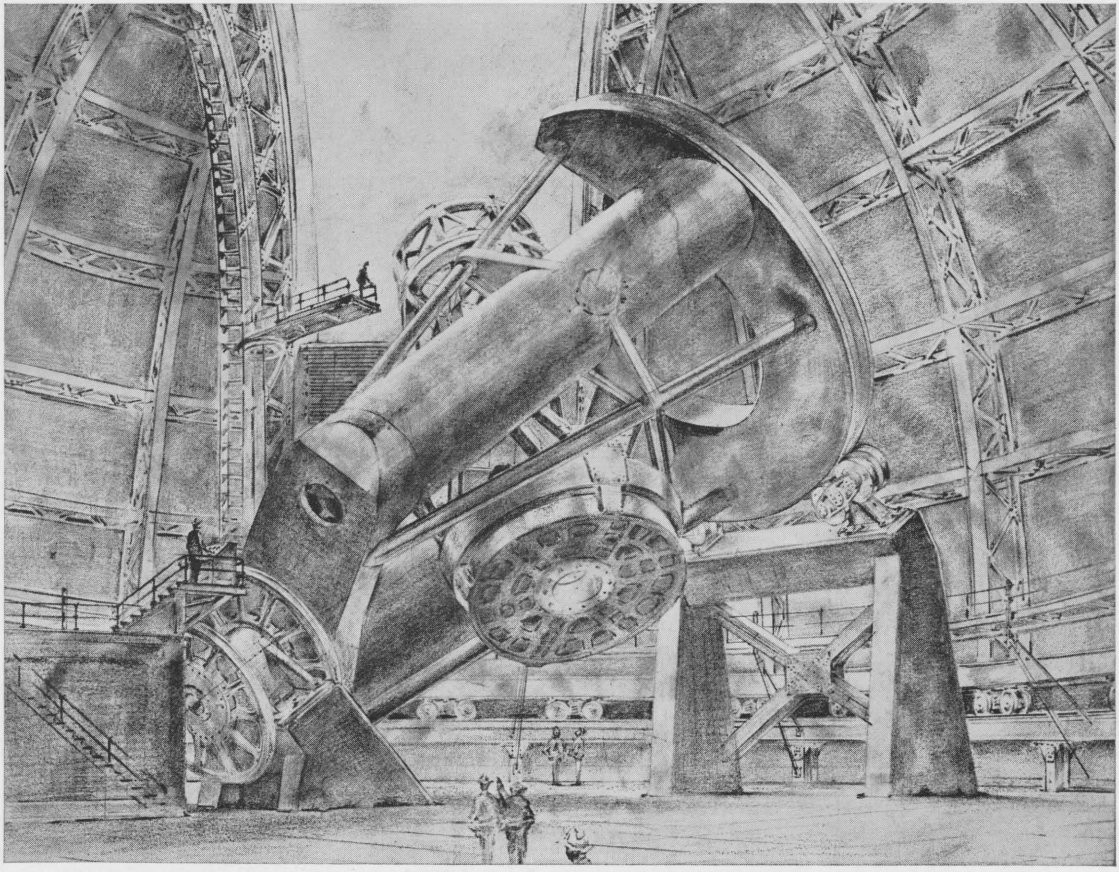

THE 200-INCH TELESCOPE as it will appear when completely assembled and mounted in the observatory on Palomar Mountain is shown in this picture supplied by the California Institute of Technology. The 200-inch mirror pierced with a central hole is shown in position at the base of the telescope tube.

PALOMAR MOUNTAIN OBSERVATORY SITE is at an elevation of 5568 feet. San Diego County is building a road 11.8 miles long up the south side of the mountain to connect with a State road to the site.

How 200-inch Mirror Will Function

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for the 200-inch telescope and for the 18-inch telescope, the power house for the large telescope, a million-gallon water reservoir and a 75-foot water tower to provide adequate pressure for the entire site. The cottages will be termite, fire and earthquake proof and all other structures will be designed with equal precaution.

Work on the 18-inch Schmidt telescope observatory was started this month. The small telescope is to be a permanent addition to the 200-inch mirror telescope and will be used principally as a scouting instrument.

MIRROR HAS ARRIVED

Early this month the 200-inch mirror on which the eyes of the scientific world are now centered arrived in Pasadena from Corning, New York, on special cars. Three years will elapse before completion of the polishing and grinding of the mirror and before it is ready to mount in the observatory of the California Institute on Palomar Mountain.

The mirror is now at the California Institute of Technology at Pasadena where a special optical laboratory has been constructed in which the mirror will be ground. This building is lined with cork and is so constructed that no sunlight will be permitted to enter.

The three years during which the grinding and polishing are under way, the temperature within the laboratory will be controlled within very slight variations.

Recently a contract was let for the construction of the support for the world's greatest telescope to cost $1,750,000. The office of Dr. Robert A. Millikan of the California Institute of Technology forwards the following interesting information:

TOTAL WEIGHT 425 TONS

"The tube of the telescope, about 20 feet in diameter and 60 feet long, will weigh about 125 tons. This includes the 200-inch mirror, lying on a special support system at the lower end of the tube. The glass disc will weigh about 16 tons after it has been ground and polished.

The telescope tube must be rigid enough to carry an observer in the cartridge-shaped house at its upper end without flexure. It must also be mounted so as to turn freely to all parts of the heavens and to follow the stars automatically with great precision in their apparent motion from east to west. The total weight of the moving parts of the telescope, including gears and accessories, will be about 425 tons.

"Other optical combinations will enable the observer to photograph celestial objects or to study them with spectroscopes, photo-electric cells and special auxiliary apparatus at several different points. One of these is at the base of the telescope tube, below the 200-inch mirror, which will be pierced with a central hole 40 inches in diameter.

"Another point of observation will be in one of the cylindrical tubes which form parts of the fork within which the telescope tube hangs.

FIXED TEMPERATURE CHAMBER

"Still another arrangement will permit the observer to work in a fixed constant temperature chamber at the south end of the polar axis. At this point the largest and most powerful spectroscopes will be mounted on a massive concrete pier.

"The entire telescope will stand within a dome 135 feet in diameter. By opening the shutters of this dome an aperture 30 feet wide, extending from the horizon to beyond the zenith, will provide a large window for observation. The lower cylindrical part of the building, fixed in position, will contain many rooms, laboratories and photographic dark rooms for various kinds of work. The dome will rotate on the circular rails at the summit.

"Contrary to many incorrect reports, the magnifying power of the 200-inch telescope will always be low or moderate. The advantage of this instrument will be its great light concentrating power. This will enable it to detect very remote celestial objects, and thus to increase our knowledge of the constitution of the universe and the nature of its apparent "expansion." The increased brightness of the images of stars and nebulae already known will permit their spectra to be photographed with spectrographs of higher dispersion than those now employed."

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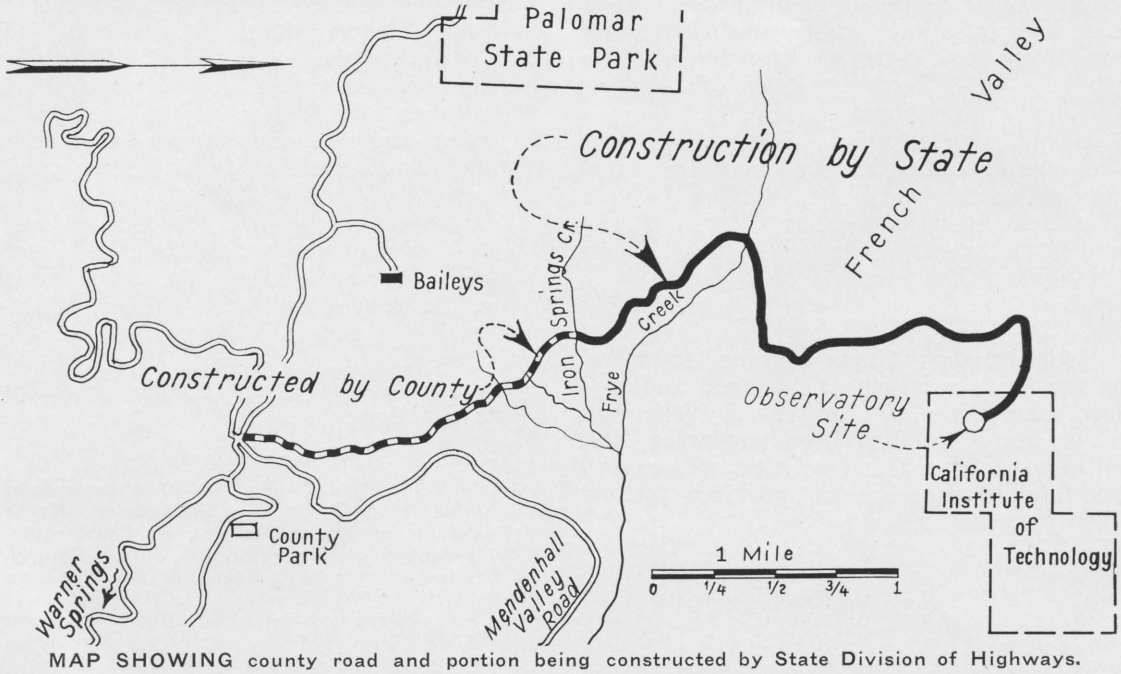
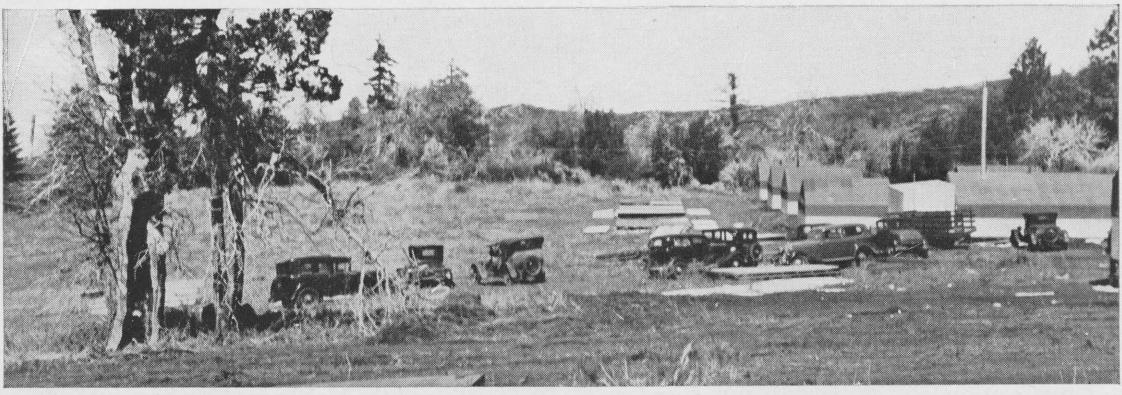
TOUGH GOING on existing trail road to camp and observatory site on Palomar Mountain.



MAP SHOWING county road and portion being constructed by State Division of Highways.



CONTRACTORS' CAMP near mountain observatory site is a rapidly growing community.